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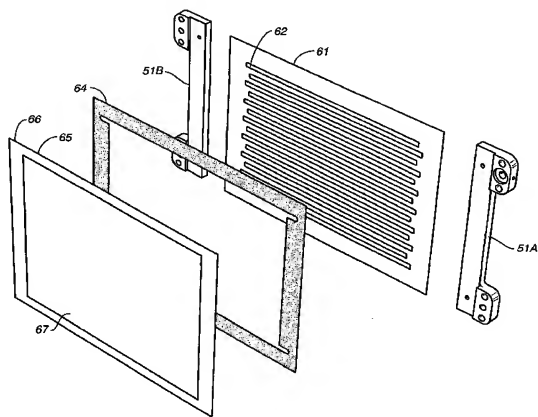
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[Continued on next page]

(54) Title: INTEGRATED AND MODULAR BSP/MEA/MANIFOLD PLATES AND COMPLIANT CONTACTS FOR FUEL CELLS



(57) Abstract: The present invention concerns improvements in fuel cell fabrication. Arrays of independent acting compliant electrical contacts are incorporated within a fuel cell which improve fuel cell operation by creating uniform and intimate electrical contact with the adjacent membrane electrode assembly (MEA). These compliant electrical contacts provide substantial uniform internal pressure distribution and substantially uniform electrical contact. In one embodiment, the array of compliant electrical contacts are in the form of a plurality of metal springs of various configurations which are electrically and mechanically contacted to a conducting base plate. In another embodiment the array of compliant electrical contacts are in the form of a plurality of small metal pins or rods which are electrically and mechanically contacted to a conducting base plate. It concerns improved, integrated and modular BSP/MEA/Manifolds, which facilitates single cell (module) leak and performance testing prior to assembly in a fuel cell stack as well as facilitating manufacturing and cost reduction. In particular, the present invention relates to a fuel cell, which includes: a) A single flex-

ible or ridged separator plate; b) a flexible membrane electrode assembly; c) a flexible bond interposed between said single flexible or ridged separator plate and said flexible membrane electrode assembly, wherein said flexible bond between said flexible or ridged separator plate and said flexible membrane electrode assembly comprises the fuel cell, and wherein said flexible bond is an adhesive bond which encapsulates edge-portions of said flexible or ridged separator plate and said flexible membrane electrode assembly and wherein said flexible bond seals the edge portions of said flexible membrane electrode assembly to prevent the release of reactants from the fuel cell. In some embodiments the adhesive bond comprises a flexible gasket; d) manifold for the delivery and removal of reactants and reactant products to and from the fuel cell reactive areas where said manifolds may be either a single or multiple manifolds; and e) a bond interposed between said manifold and said single flexible or ridged separator plate, wherein said bond affixes said manifold to said flexible or ridged separator plate and wherein said bond provides a seal between said manifold and said flexible or ridged separator plate to prevent the release of reactants from the fuel cell. It also eliminates some gaskets and simplifies assembly.



IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— *with international search report*

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/24105

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M8/02 H01M8/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 604 683 A (BALLARD POWER SYSTEMS) 6 July 1994 (1994-07-06)	1
A	claims 1-10	2-10, 19-22, 60-65
A	----- US 6 060 189 A (MERCURI ROBERT ANGELO ET AL) 9 May 2000 (2000-05-09)	1-10, 19-22, 60-65
A	claims 1,2 ----- DE 196 24 887 A (FRAUNHOFER GES FORSCHUNG) 2 January 1997 (1997-01-02)	1-10, 19-22, 60-65
	claims 1-25 ----- -/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

23 April 2003

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/24105

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 743 519 A (KAJI HISATSUGU ET AL) 10 May 1988 (1988-05-10) claims 1-8 -----	1-10, 19-22, 60-65
A	US 4 609 595 A (NICKOLS RICHARD C) 2 September 1986 (1986-09-02) claims 1-12 -----	1-10, 19-22, 60-65

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 01/24105

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 16,42-45
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
extreme unclear wording do not allow to understand the scope of these claims
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-10,19-22,60-65

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10,19-22,60-65

a fuel cell comprising a flexible membrane electrode assembly having a flexible sealing element between the separator plate and the flexible membrane electrode assembly

2. claim: 11

A fuel cell comprising a flexible membrane electrode assembly wherein the seal forms part of the reactant flow field

3. claims: 12-15,18

a fuel cell comprising a flexible membrane electrode assembly wherein the manifolds are external to the separator plates and the membrane electrode assembly.

4. claim: 17

a fuel cell comprising a flexible membrane electrode assembly wherein the manifolds have passages for a single reactant or coolant or passages for multiple reactants or coolants

5. claims: 23-41,46-59,66

An array of independently acting compliant electrical contacts

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/24105

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